

# Water Quality Monitoring of Abiotic and Biotic Factors in an Effluent-Dominated Segment of the South Platte River: Quantifying Overall Improvements in the Aquatic Environment



Jordan Parman  
Water Quality Scientist  
March 28, 2019



NWQMC National  
Monitoring Conference  
Denver, Colorado

# Presentation Overview

- Introduction to Metro Wastewater Reclamation District
- Background on Segment 15 of the South Platte River
- Monitoring Program Overview
- Examples of How Data Are Used
- Conclusions and Future Work



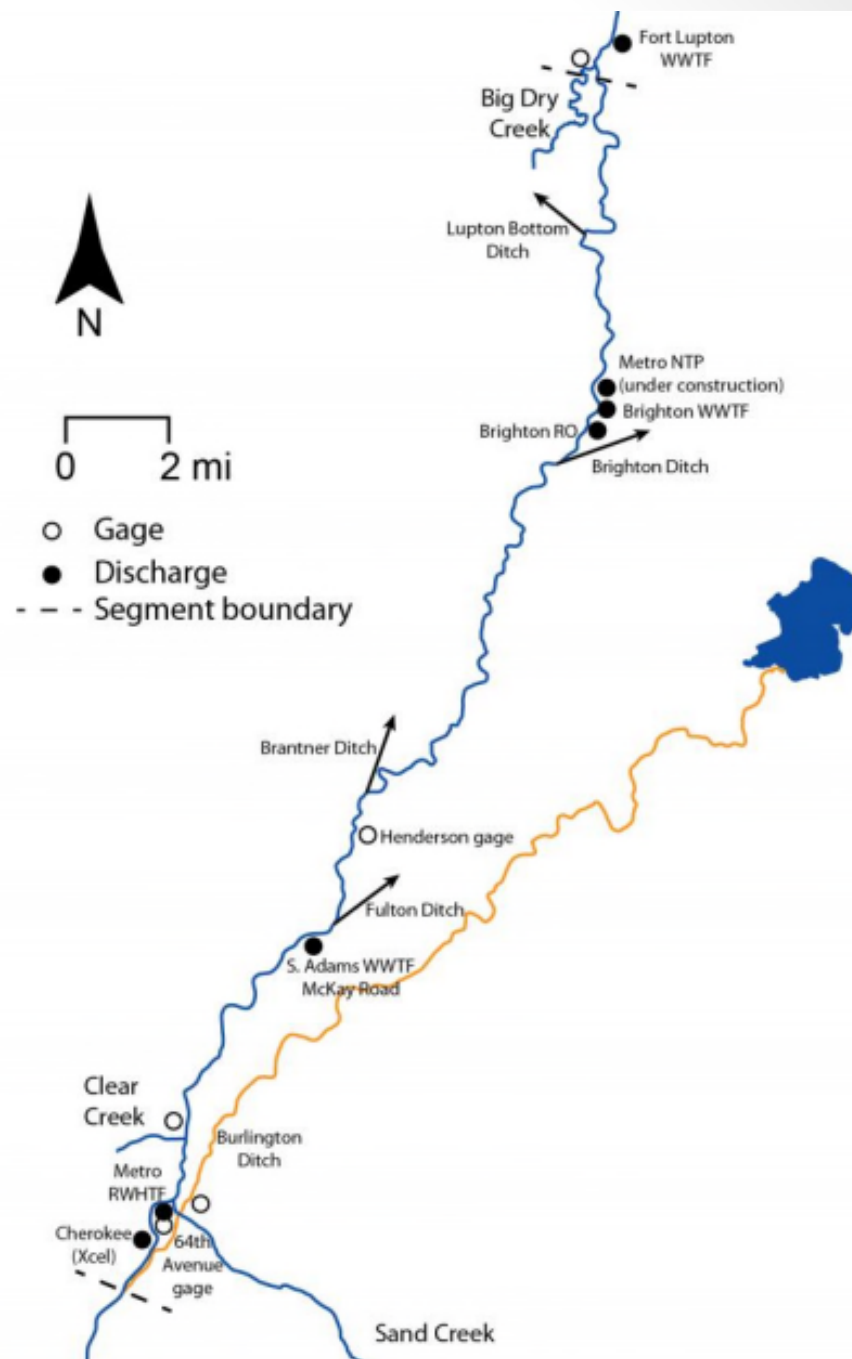
# Metro Wastewater Reclamation District

- Serve ~ 2 million people in Metro Denver area
- Treat ~ 130 MGD
- Discharge into effluent-dominated segment of the South Platte River
- History of continuous treatment upgrades with immediate in-stream impact



# Segment 15 of South Platte River

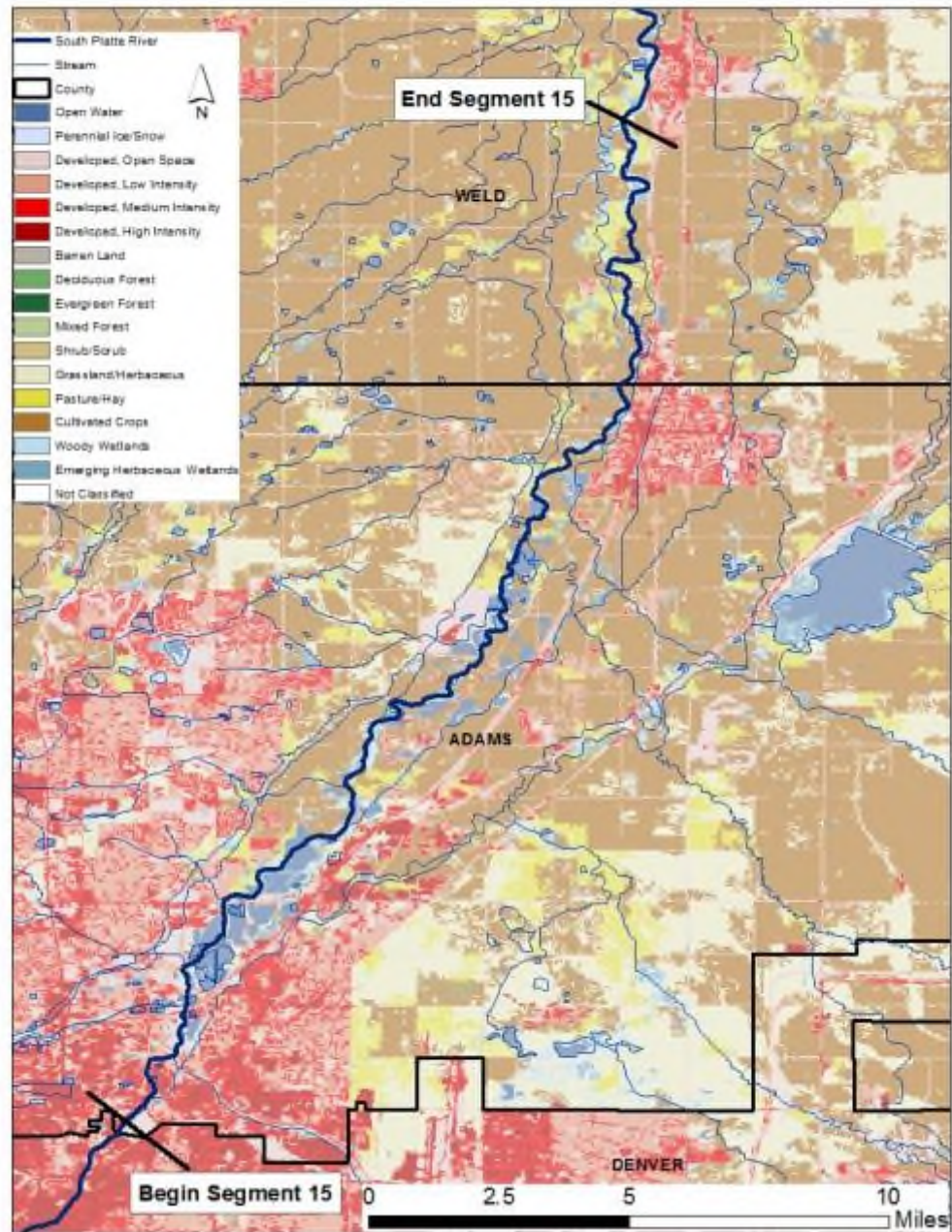
- Effluent-dominated
- Numerous ditch withdrawals
- Channelized
- Transition to agricultural land use downstream
- Warm water fish species






# Segment 15 of South Platte River

- Effluent-dominated
- Numerous ditch withdrawals
- Channelized
- Transition to agricultural land use downstream
- Warm water fish species



# Segment 15 of South Platte River



**South Platte at 64<sup>th</sup> Avenue  
(Upstream of Outfalls)**

**~2.0 cfs**



# Segment 15 of South Platte River



**South Platte at RWHTF Outfalls**

**~222 cfs**

# Segment 15 of South Platte River

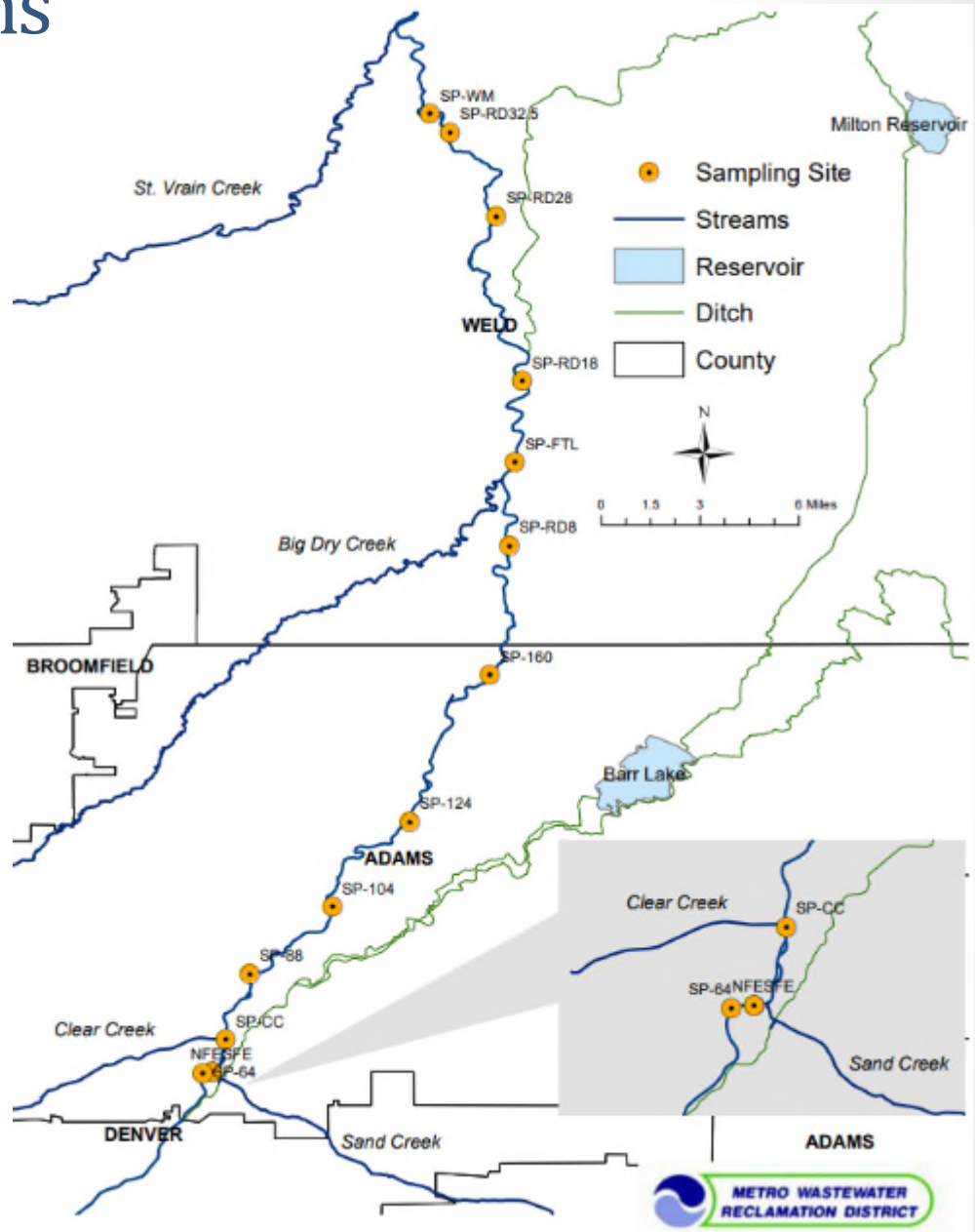
**South Platte ~ 1 miles downstream of outfalls  
~240 cfs**





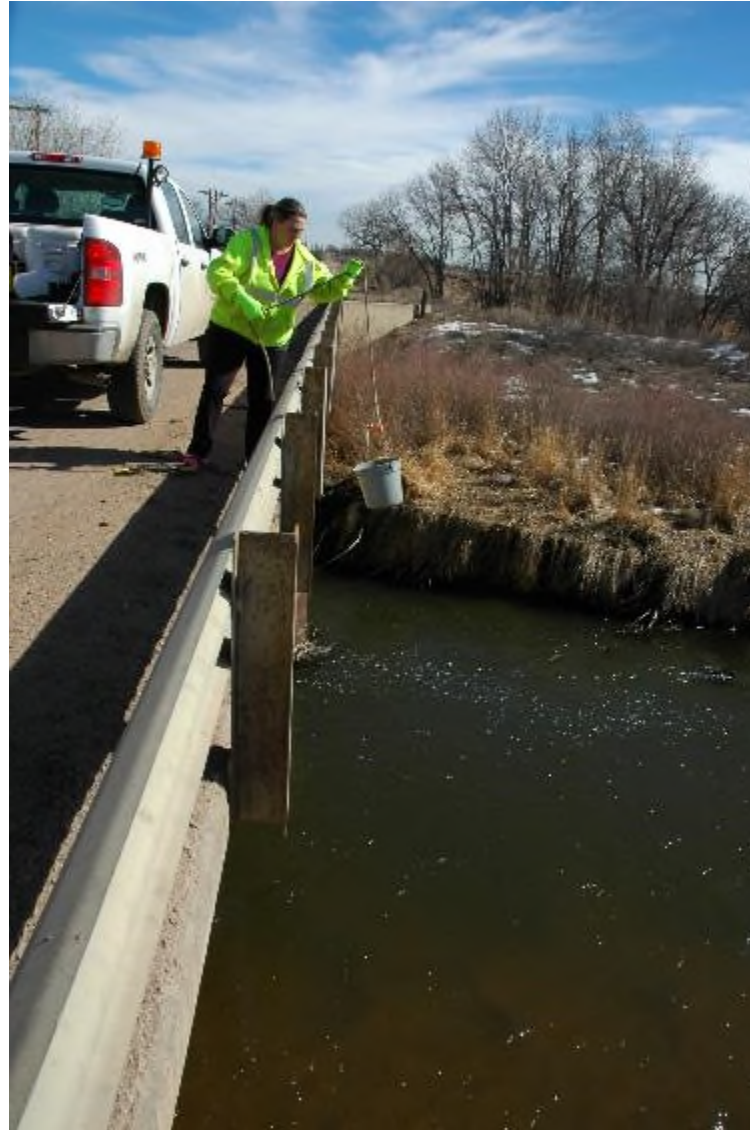
# Monitoring Programs

- Biweekly stream chemistry (mainstem, tributaries, effluent)
- 24-hour stream sampling events
- Groundwater (co-located with streams sites)
- Fish surveys (100-meter electrofishing)
- Macroinvertebrate surveys (kicknet and multi-habitat sampling)
- Habitat Sampling



# Monitoring Programs

- Biweekly stream chemistry (mainstem, tributaries, effluent)
- 24-hour stream sampling events
- Groundwater (co-located with streams sites)
- Fish surveys (100-meter electrofishing)
- Macroinvertebrate surveys (kicknet and multi-habitat sampling)
- Habitat Sampling





# Monitoring Programs

- Biweekly stream chemistry (mainstem, tributaries, effluent)
- 24-hour stream sampling events
- Groundwater (co-located with streams sites)
- Fish surveys (100-meter electrofishing)
- Macroinvertebrate surveys (kicknet and multi-habitat sampling)
- Habitat Sampling



# Monitoring Programs

- Biweekly stream chemistry (mainstem, tributaries, effluent)
- 24-hour stream sampling events
- Groundwater (co-located with streams sites)
- Fish surveys (100-meter electrofishing)
- Macroinvertebrate surveys (kicknet and multi-habitat sampling)
- Habitat Sampling

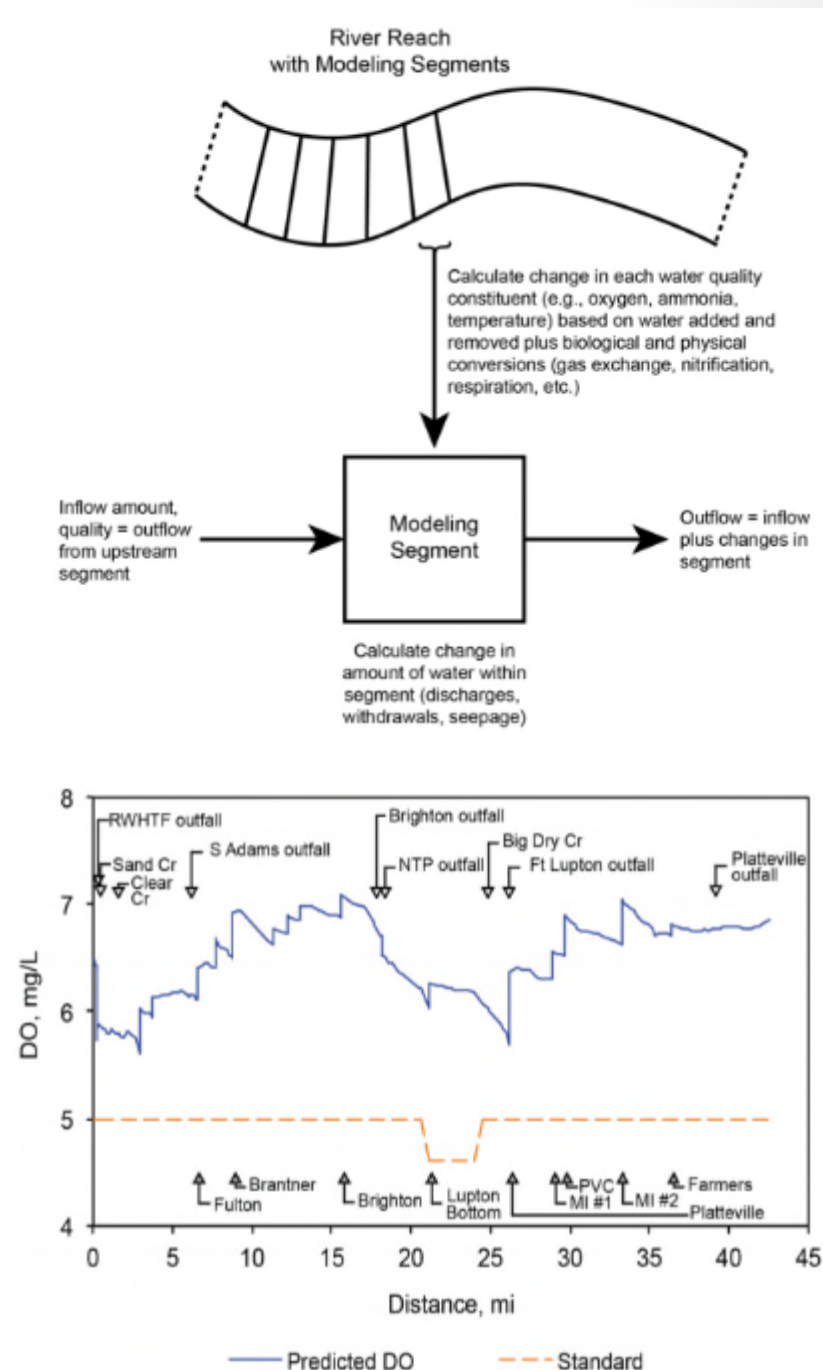




# How are Data Used?

## South Platte Water Quality Model

- Systems model for conservative and non-conservative constituents
- ~ 350 meter modeling reach intervals
- Estimate river metabolism combining routine monthly monitoring and special 24-hour studies
- Informs permitting and quantifies in-stream chemistry changes following major treatment plant upgrades

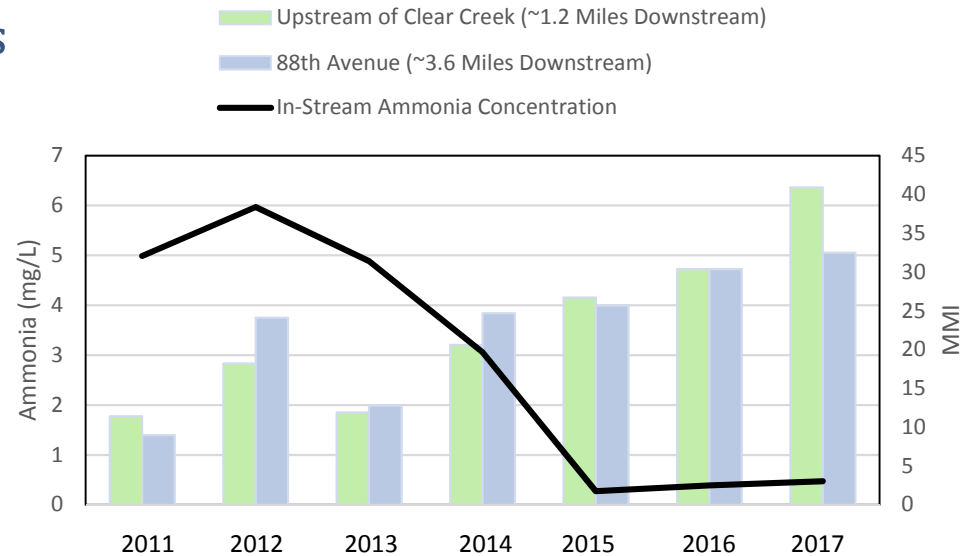


# How are Data Used?

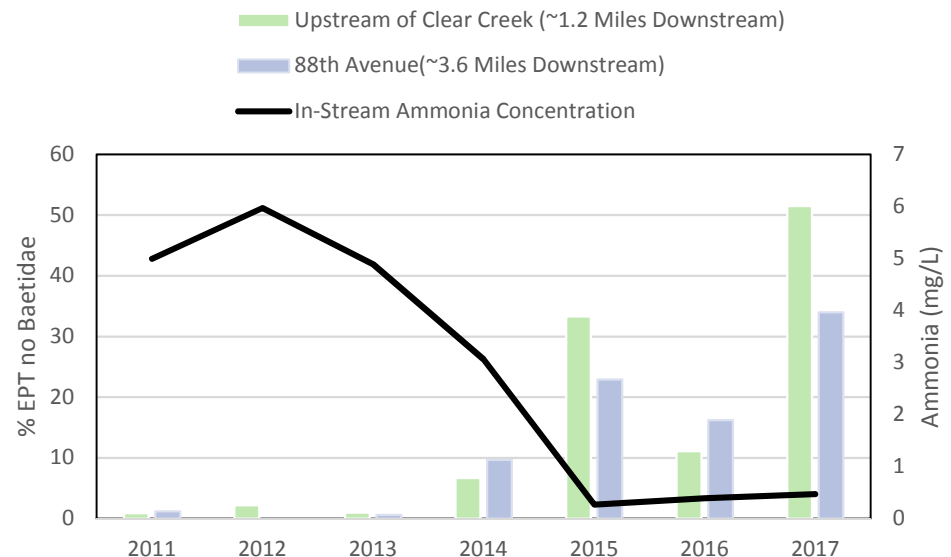
## Impact of Treatment Plant Upgrades

- Average annual effluent ammonia concentration dropped from **> 10 mg/L in 2013 to 0.5 mg/L in 2015** due to treatment plant upgrades
- Downstream macroinvertebrate community transitioned from *Tubificidae/Chironomidae* dominant to greater %EPT
- ANOVA before/after ammonia reductions shows significant increases in Colorado MMI at three closest downstream monitoring locations ( $p < 0.05$ )

Colorado Multi-Metric Index (MMI)



% EPT Excluding *Baetidae* of All Individuals

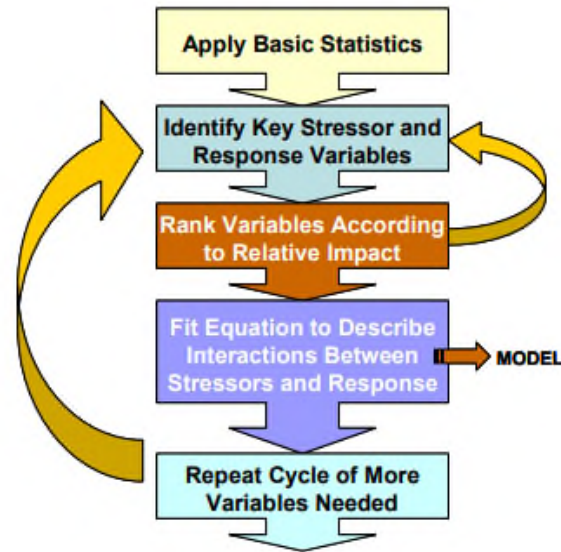




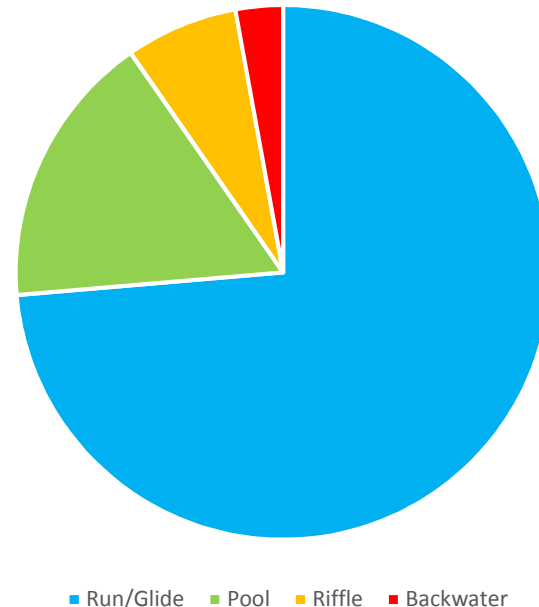
# How are Data Used?

## Limiting Factors Analysis

- Identify whether chemical or habitat variables are more significant in determining biological variables
- Multivariate statistical approach using all data in a holistic fashion
- No evidence of particular water quality (chemical) concern
- Habitat improvements most effective approach



Average Habitat Percentages



# How are Data Used?

## Impact of In-Stream Habitat Improvements



Pre-Construction (2013)



# How are Data Used?

## Impact of In-Stream Habitat Improvements



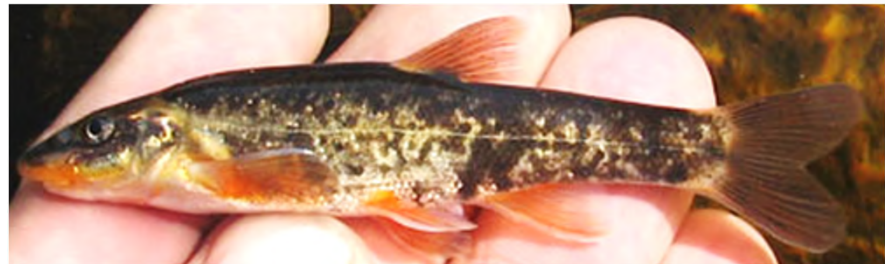
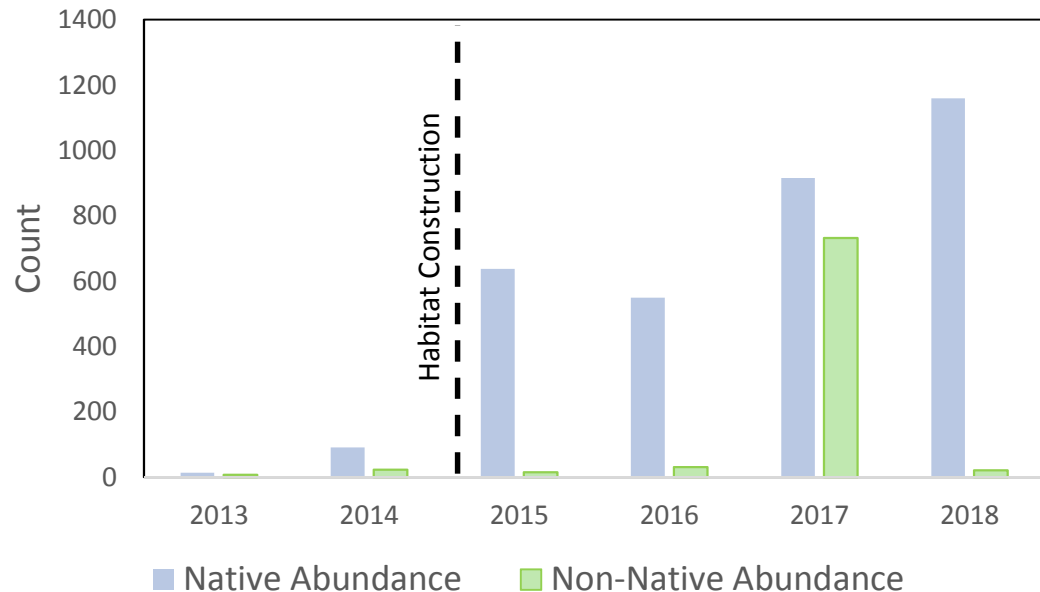
Post-Construction (2018)

# How are Data Used?

## Impact of In-Stream Habitat Improvements

- Only 14 individual native fish caught in 2013 prior to construction
- Drastic increase in longnose dace in constructed riffle
- White suckers and green sunfish moved into secondary channel
- Immediate improvements in overall native fish abundance and diversity

Phase III Habitat Improvement Native vs. Non-Native Fish Abundance



# Conclusions and Future Plans

- Biological data is highly variable, but can show significant improvements due to treatment upgrades and in-stream habitat modifications
- Need combination of long-term routine monitoring and special studies
- Future areas of focus:
  - Temperature
  - Nutrient response
  - Biological condition





# Questions...

Jordan Parman  
Water Quality Scientist  
Metro Wastewater Reclamation District  
[jparman@mwr.dst.co.us](mailto:jparman@mwr.dst.co.us)

